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ABSTRACT

This is the teacher's guide for a training program designed to educate students and individuals in the importance of conserving energy and to provide for developing skills needed in the application of energy-saving techniques that result in energy efficient buildings. Alternatives are provided in the program to allow for specific instruction in energy-saving methods and procedures, or for integration with construction courses. It may also be used for self-paced instruction. The materials are divided into three parts: (1) Understanding and practicing energy conservation; (2) Determining amount of energy lost or gained in a building; and (3) Determining which practices are more efficient and installing materials. (Author/DS)

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Prepared for the U.S. Department of Energy

June 1980

Office of Consumer Affairs
Education Division
Washington, D.C. 20585

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Providing for Energy Efficiency in Homes and Small Buildings

Teacher Guide

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U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
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SE 032 944

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Preface

This Teacher Guide parallels the basic manual, PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS:

PART ONE: UNDERSTANDING AND PRACTICING ENERGY CONSERVATION IN BUILDINGS.

PART TWO: DETERMINING AMOUNT OF ENERGY LOST OR GAINED IN A BUILDING.

PART THREE: DETERMINING WHICH PRACTICES ARE MOST EFFICIENT AND INSTALLING MATERIALS.

The Guide gives answers to questions in the Student Workbook and directions for special exercises and problems related to the subject. It is suggested that the teacher use this guide in preparing lesson plans and teaching the course.

An audio/visual paralleling the manuals is available from AAVIM. Write for prices.

Part One:
UNDERSTANDING AND PRACTICING ENERGY CONSERVATION IN BUILDINGS

I. Understanding Importance of Energy

A. What is Energy?

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Pages 1-25)

Overview:

This lesson serves to acquaint the student with forms of energy, conditions of energy, conversions of energy and scientific laws of energy.

Objectives:

The student will be able to perform the following:

1. Identify forms of energy.
2. Describe the three methods of heat flow.
3. Explain the two conditions of energy, kinetic and potential.
4. Explain how energy becomes most useful when converted from one form to another.
5. State the scientific laws of energy, conservation and efficiency.

Tools and Materials Needed:

1. Examples of the different forms of energy such as mechanical and heat.
2. Audiovisual.

   (Note: An audiovisual paralleling this program is available from AAVIM.)

Estimated Audiovisual Time:

2 Hours.

Teaching Strategies:

1. Make reading assignment in manual prior to class.
2. Ask students to bring examples of energy forms to class.
3. Show audiovisual.
4. Discuss and demonstrate principles of energy forms, conditions, conversions and laws. Encourage student participation.
5. Have students answer questions in student workbook.

Evaluation:

1. Check answers in student workbook, page 5, as follows:

   1-2a, 5b, 1c, 4d, 3e, 6f; 2c; 3d; 4c; 5b; 6-1a, 2b, 2c, 1d, 2e.

2. Evaluate performance of students in student workbook.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.
2. Suggest that students become more aware of energy, its forms and resources in their daily activities.

B. What Are the Primary Known Sources of Energy?

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Page 26)

Overview:

This lesson serves to acquaint the student with the primary sources of renewable and nonrenewable energy and a brief history of energy resources and their consumption in the United States.

Objectives:

The student will be able to perform the following:

1. List the primary sources of energy and state which ones are renewable and nonrenewable.
2. Indicate the importance of these energy resources during the past 100 years.

Tools and Materials Needed:

1. Graphs showing sources of energy.
2. Audiovisual.

Estimated Time:

1/2 Hour.

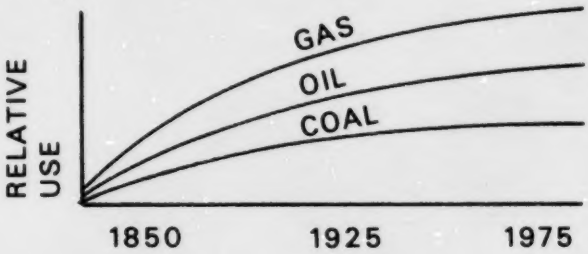
Teaching Strategies:

1. Make reading assignment prior to class.
2. Show graphs and discuss the primary sources of energy and a brief history of their consumption in the United States.
3. Have students answer questions in the student workbook.

Evaluation:

1. Check answers in student workbook, page 6, as follows:

1-Na, Nb, Rc, Nd, Re, Nf, Rg;
2-



Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

C. What Are the Major Uses of Energy?

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Page 27)

Overview:

This lesson is to give the student a view of the relative uses of energy and to impress upon the student the significance of energy use in homes and buildings. Also, it mentions several factors that greatly influence energy consumption in buildings.

Objectives:

The student will be able to perform the following:

1. Give the relative uses of energy in the residential, commercial, transportation and industry sectors.
2. Name some factors that influence the use of energy in buildings.

Tools and Materials Needed:

1. Graph showing relative uses of energy.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Make reading assignment in manual prior to class.
2. Show graph and discuss relative uses of energy and mention factors that influence energy consumption in buildings (See Figure 32).
3. Have students answer questions in the student workbook.

Evaluation:

1. Check answers in student workbook, page 7, as follows:

   1-26a, 24b, 14c, 36d;
   2-conservation; 3a, b.

Follow-Up and Reinforcement:

1. Review answers to questions in student workbook.
2. Suggest that students become more observant of energy uses.
3. Review sections A, B and C.

II. Developing a Concern for Conserving Energy

A. How Long Will the Present Supply of Fossil Energy Last?

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Pages 30-32)

Overview:

This lesson is to impress upon the student the critical situation with respect to the limited supply of fossil fuels: coal, oil and natural gas.

Objectives:

The student will be able to perform the following:

1. Estimate the increase in rate of energy consumption in the U.S.
2. Observe the high use of energy in the U.S. as compared to the rest of the world.
3. Discuss the known and estimated sources of fossil fuels in the U.S.
4. Estimate the time required to deplete known sources at our present rate of consumption.

Tools and Materials Needed:

1. Graphs showing trends in uses and sources of energy (See Figures 31, 32, 33, 34 and 35).

Estimated Time:

1 Hour.

Teaching Strategies:

1. Make reading assignment prior to class.
2. Show graphs from manual and discuss consumption and supply trends of fossil fuels.
3. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 8, as follows:

   1b; 2-6 and 35; 3b, 4a.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.
2. Point out the need for developing alternate sources of energy.

B. What Are the Prospects for Alternate Sources of Energy?

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Pages 33-40)

Overview:

This lesson is to describe alternate sources of energy and to discuss their potential.

Objectives:

The student will be able to perform as follows:

1. List alternate sources of energy.
2. Explain their importance.

Tools and Materials Needed:

1. Examples and/or models of alternate sources of energy.
2. Audiovisual.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Make reading assignment prior to class.
2. Ask students to come prepared to discuss alternate sources.

   Assign students different subjects for special reports.
3. Show audiovisual.
4. Discuss and demonstrate (if possible) alternate sources.
5. Encourage audience participation.
6. Ask students to answer questions in student workbook.
7. Conduct exercise in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 9, as follows:

   1b; 2c; 3-oil and gas; 4a; 5-uranium; 6b; 7-50%; 8c; 9a; 10b.
2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

C. What Effect May the Energy Situation Have on an Individual?

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Page 41)

Overview:

This lesson is to stimulate thinking toward a more efficient use of energy and its effect on an individual.

Objectives:

The student will be able to perform the following:

1. Discuss the pending high cost of energy and its effect on individuals.

Tools and Materials Needed:

1. Audiovisual.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Make reading assignment prior to class.
2. Ask students to bring suggestions for alternate lifestyles.
3. Show audiovisual.
4. Discuss effects on individuals.
5. Ask students to answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 10, as follows:

   1b; 2-imbalance of payments; 3-2%; 4-smaller houses, mass transportation, smaller autos, reduction in conditioned space.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.
2. Review sections A, B and C.

III. Understanding the Use of Energy in Buildings

A. How is Energy Used in Buildings?

(Ref. PROVIDING FOR ENERGY EFFICIFNCY IN HOMES AND SMALL BUILDINGS, Part One, Pages 43-48)

Overview:

This lesson is to acquaint the student with the distribution of energy consumption in buildings. The student should be aware that space heating (and cooling) and water heating are the prime users of energy in buildings.

Objectives:

The student will be able to perform as follows:

1. Name the prime users of energy in buildings in order of their importance.

Tools and Materials Needed:

1. Audiovisual.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Assign reading prior to class.
2. Ask students to survey their homes for energy-consuming aspects.
3. Show audiovisual.
4. Discuss ways energy is used in buildings.
5. Ask students to answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 11, as follows:

   1a; 2b; 3c; 4c; 5a.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

B. How Does Geographic Location Affect Energy Use in Buildings?

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Pages 49-55)

Overview:

To compare factors which influence energy consumption between climatic and geographic locations.

Objectives:

The student will be able to perform as follows:

1. Name the climatic conditions that affect energy use in buildings.
2. Describe the importance of sun in space heating.

Tools and Materials Needed:

1. Audiovisual.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Make reading assignment prior to class and answer questions.
2. Ask students to be able to compare energy consumption in their climate and energy consumption in other climates.
3. Show audiovisual.
4. Discuss and demonstrate energy consumption according to climates.
5. Ask students to answer questions in student workbook.

Evaluation:

1. Have students answer questions in student workbook, page 12, as follows:

   1-a,b,c,d; 2-temperature; 3a; 4a.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

C. How Design and Construction Methods Affect Energy Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Pages 56-71)

Overview:

This lesson is to acquaint the student with the importance of design and construction methods and how they affect energy consumption.

Objectives:

The student will be able to perform as follows:

1. Name the design and construction factors that influence energy consumption and tell how each can be made more efficient.

Tools and Materials Needed:

1. Audiovisual.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Make reading assignment prior to class.

2. Ask students to come prepared to discuss the design and construction methods of their own homes and tell how they could be made more energy efficient.

3. Show audiovisual.

4. Discuss and demonstrate (if possible) factors influencing energy consumption.

5. Ask students to answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 12, as follows:

   1-2a, 4b, 1c, 3d; 2b; 3a; 4c; 5a; 6c.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

D. General Recommendations for Energy Efficiency in Buildings

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Page 72)

Overview:

This lesson is to give the student enough information to make decisions regarding retrofitting an existing house or equipping a new house for energy efficiency with a minimum of technical effort.

Objectives:

The student will be able to perform as follows:

1. List the most important jobs to do in providing for energy efficiency in buildings.

2. Determine the R-value needed for insulation in your general locality.

Tools and Materials Needed:

1. Figure 105 and Table IX.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Make reading assignment prior to class.

2. Ask students to come prepared to discuss needs for improving the energy efficiency of their own dwellings.

3. Discuss and give examples of improving energy efficiency in buildings.

4. Conduct exercise in student workbook.

Evaluation:

1. Evaluate student performance for exercise in student workbook.

Follow-Up and Reinforcement:

1. Review exercise.

2. Review sections A, B, C and D.

IV. Care and Maintenance of Energy-Efficient Buildings

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Pages 74-76)

Overview:

This lesson is to call attention to the many details that can be done to improve energy efficiency in homes and small buildings.

Objectives:

The student will be able to perform as follows:

1. List service, maintenance and operational jobs that should be done to buildings in the spring and in the fall.

Tools and Materials Needed:

1. Examples.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Make reading assignment prior to class.

2. Ask students to audit their own dwellings and/or the school building.

3. Discuss and demonstrate energy audit and jobs to be done.

4. Have students answer questions in student workbook.

5. Conduct exercise in student workbook.

Evaluation:

1. Check answers in student workbook, page 14, as follows:

   1a; 2d; 3b; 4b; 5b; 6a; 7a; 8b; 9b; 10a; 11e; 12b; 13b; 14c; 15b; 16b.

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Discuss questions and answers in student workbook.

V. Developing Energy-Saving Habits

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part One, Pages 78-86)

Overview:

This lesson is to point out many routine practices that can be followed with very little effort that will help conserve energy.

Objectives:

The student will be able to perform as follows:

1. List several practices that a person can do regularly that will help conserve energy.

2. Perform a survey to determine which practices are being followed in their homes, schools and other buildings.

Tools and Materials Needed:

1. Examples.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Make reading assignment prior to class.

2. Ask students to complete exercises in student workbook at home.

3. Discuss and demonstrate energy-saving practices for individuals in buildings.

4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 16, as follows:

   1d; 2b; 3c; 4a; 5a; 6b; 7c; 8c; 9b; 10a; 11a; 12c; 13c; 14a; 15b; 16d; 17a; 18b; 19b; 20b; 21b; 22a; 23b; 24a; 25b; 26b; 27b; 28b; 29b; 30e; 31d; 32a; 33a; 34a; 35a; 36a; 37b.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

2. Review exercise in student workbook.

Part Two:
DETERMINING AMOUNT OF ENERGY LOST OR GAINED IN A BUILDING

I. Determining Amount of Energy Lost or Gained in a Building

A. Terms Used to Measure Energy in Buildings

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Two, Pages 11-16)

Overview:

This lesson is to introduce the student to technical evaluation of heat losses and gains in buildings. It discusses heat flow through building components and terms used for measuring heat flow.

Objectives:

The student will be able to perform as follows:

1. Name and define terms used to measure heat flow.

Tools and Materials Needed:

1. Examples.
2. Audiovisual.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Make reading assignment prior to class.
2. Show audiovisual.
3. Discuss material in the manual.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 21, as follows:

   1-1b, 2e, 3a, 4e, 5d; 2-1b, 2a, 3d, 4c; 3-1b, 2i, 3j, 4f, 5g, 6d, 7k, 8c, 9h, 10e, 11a.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

B. Understanding Heat Losses and Gains in Buildings

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Two, Pages 17-23)

Overview:

This lesson is to familiarize the students with mathematical formulas for computing heat losses and gains in buildings and to explain how they are used.

Objectives:

The student will be able to perform as follows:

1. Substitute the proper terms in formulas.

2. Work simple problems.

Tools and Materials Needed:

1. Examples.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Make reading assignment prior to class.

2. Discuss material in the manual. Work examples on blackboard.

3. Have students answer questions in workbook.

Evaluation:

1. Check answers to questions in student workbook, page 22, as follows:

   1-1b, 2a, 3c; 2a; 3a;
   4-844.8 Btu/hr; 5-3,456 Btu/hr;
   6c.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

C. Estimating Heat Loads in Buildings

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Two, Pages 25-34)

Overview:

This lesson is to give procedures for calculating heat loads in a building. The problem can then be used as a guide for figuring heat loads for other buildings.

Objectives:

The student will be able to perform as follows:

1. Calculate heat loss from buildings.
2. Calculate heating load for buildings.
3. Compare energy-saving practices.

Tools and Materials Needed:

1. Special problem building.
2. Cooling and heating load calculation manual, GRP 158, ASHRAE.

Estimated Time:

8 Hours.

Teaching Strategies:

1. Make reading assignment prior to class.
2. Explain procedures given in manual.
3. Have students work problems in student workbook.
4. Have students work special problems for a given building.

Evaluation:

Check answers to problems in workbook, pages 23, 24, 25, 26, and 27:

1. Problem No. 1, See Worksheet A.
2. Problem No. 2, See Worksheet B.
3. Problem No. 3, See Worksheet C.
4. Evaluate student performance on special problem.

Follow-Up and Reinforcement:

1. Review problems in student workbook.

WORKSHEET A. HEAT FLOW CALCULATIONS
Answers to Problem No. 1 in Workbook

Overall Heat Transfer Coefficients (U)
Exterior Walls 0.081 Btu/hr-ft^2-°F
Ceiling-Roof Combo 0.04 Btu/hr-ft^2-°F
Floors ~~Btu/hr-ft^2-°F~~
Slabs 50 Btu/hr-ft
Windows 0.58 Btu/hr-ft^2-°F
Doors 0.49 Btu/hr-ft^2-°F

Design Temperatures
Inside temperature (t_i) 65°F
Outside temperature (t_o) ~~14°F~~ 20°F

Room	Building Component	Transmission Coefficient (U)	Surface Area (A)	Temp. Difference ($t_i - t_o$)	Conduction Losses $q_c = UA(\Delta t)$	Air Exchange	Infiltration Rate (Q_i)	Infiltration Losses $q_i = .018Q_i(\Delta t)$
1	Ext. walls	.081	330	~~51~~ 45	~~1363~~ 1203			
	Ceiling-roof	.04	225	~~51~~ 45	~~459~~ 405			
	Floor	-	-	-	-			
	Slab	50*	45*	-	2250*			
	Windows	0.58	30	~~51~~ 45	~~887~~ 783			
	Doors	0.49	0	~~51~~ 45	0			
	TOTAL ROOM LOSS				~~4959~~ 4641	1.5	1800	~~1652~~ 1454
2	Ext. walls	.081	260	~~51~~ 45	~~1074~~ 948			
	Ceiling-roof	.04	300	~~51~~ 45	~~612~~ 559			
	Floor	-	-	-	-			
	Slab	50*	35*	-	1750*			
	Windows	.58	0	~~51~~ 45	0			
	Doors	.49	20	~~51~~ 45	~~500~~ 440			
	TOTAL ROOM LOSS				~~3936~~ 3677	1.0	1600	~~1468~~ 1292
3	Ext. walls	.081	495	~~51~~ 45	~~2045~~ 1800			
	Ceiling-roof	.04	500	~~51~~ 45	~~1020~~ 898			
	Floor	-	-	-	-			
	Slab	50*	70*	-	3500*			
	Windows	.58	45	~~51~~ 45	~~1330~~ 1190			
	Doors	.49	20	~~51~~ 45	~~500~~ 440			
	TOTAL ROOM LOSS				~~8395~~ 7808	2.0	5360	~~4920~~ 4330

1454 + 1292 + 4330 = 7076

*Slab Load = Factor from Table XI x Exposed Perimeter Length
Total Conduction Loss = ~~4959 + 3936 + 8395 = 17,290~~ Btu/hr
4644 + 3677 + 7808 = 16,126

Total Infiltration Loss = ~~1652 + 1468 + 4920 = 8,040~~ Btu/hr
Total Heat Loss = ~~17,290 + 8,040 = 25,330~~ Btu/hr
16,126 + 7076 = 23,202

WORKSHEET B. HEAT FLOW CALCULATIONS
Answers to Problem No. 2 in Workbook

Overall Heat Transfer Coefficients (U)
Exterior Walls 0.081 Btu/hr-ft2-°F
Ceiling-Roof Combo 0.04 Btu/hr-ft2-°F
Floors Btu/hr-ft2-°F
Slabs 50 Btu/hr-ft
Windows 0.58 Btu/hr-ft2-°F
Doors 0.49 Btu/hr-ft2-°F

Design Temperatures
Inside temperature (t_i) ~~65°F~~ 75°F
Outside temperature (t_o) 14°F

Room	Building Component	Transmission Coefficient (U)	Surface Area (A)	Temp. Difference ($t_i - t_o$)	Conduction Losses $q_c = UA(\Delta t)$		Air Exchange	Infiltration Rate (Q_i)	Infiltration Losses $q_i = .018Q_i(\Delta t)$
1	Ext. walls	.081	330	~~51~~ 61	~~1363~~	1630			
	Ceiling-roof	.04	225	~~51~~ 61	~~459~~	549			
	Floor	-	-	-	-				
	Slab	50*	45*	-	2250*				
	Windows	0.58	30	~~51~~ 61	~~887~~	1061			
	Doors	0.49	0	~~51~~ 61	0				
	TOTAL ROOM LOSS				~~4959~~	5490	1.5	1800	~~1652~~ 1976
2	Ext. walls	.081	260	~~51~~ 61	~~1074~~	1285			
	Ceiling-roof	.04	300	~~51~~ 61	~~612~~	732			
	Floor	-	-	-	-				
	Slab	50*	35*	-	1750*				
	Windows	.58	0	~~51~~ 61	0				
	Doors	.49	20	~~51~~ 61	~~500~~	898			
	TOTAL ROOM LOSS				~~3936~~	4365	1.0	1600	~~1468~~ 1756
3	Ext. walls	.081	495	~~51~~ 61	~~2045~~	2446			
	Ceiling-roof	.04	500	~~51~~ 61	~~1020~~	1220			
	Floor	-	-	-	-				
	Slab	50*	70*	-	3500*				
	Windows	.58	45	~~51~~ 61	~~1330~~	1591			
	Doors	.49	20	~~51~~ 61	~~500~~	598			
	TOTAL ROOM LOSS				~~8395~~	9355	2.0	5360	~~4920~~ 5885

*Slab Loss = Factor from Table XI x Exposed Perimeter Length
Total Conduction Loss = ~~4959~~ + ~~3936~~ + ~~8395~~ = ~~17,290~~ Btu/hr
Total Infiltration Loss = ~~1652~~ + ~~1468~~ + ~~4920~~ = ~~8,040~~ Btu/hr
Total Heat Loss = ~~17,290~~ + ~~8,040~~ = ~~25,330~~ Btu/hr

5490 + 4365 + 9355 = 19,210 Btu/hr
1976 + 1756 + 5885 = 9,617 Btu/hr
19,210 + 9,617 = 28,827 Btu/hr

WORKSHEET C. HEAT FLOW CALCULATIONS
Answers to Problem No. 3 in Workbook

Overall Heat Transfer Coefficients (U)
Exterior Walls 0.110 Btu/hr-ft²-°F
Ceiling-Roof Combo 0.07 Btu/hr-ft²-°F
Floors Btu/hr-ft²-°F
Slabs 50 Btu/hr-ft
Windows 0.58 Btu/hr-ft²-°F
Doors 0.49 Btu/hr-ft²-°F

Design Temperatures
Inside temp (t_i) 65°F
Outside temp (t_o) 14°F

Room	Building Component	Transmission Coefficient (U)	Surface Area (A)	Temp. Difference ($t_i - t_o$)	Conduction Losses $q_c = UA(\Delta t)$	Air Exchange	Infiltration Rate (Q_i)	Infiltration Losses $q_i = .018Q_i(\Delta t)$
1	Ext. walls	~~.081~~ 0.110	330	51	~~1363~~ 1851			
	Ceiling-roof	~~.04~~ 0.07	225	51	~~459~~ 803			
	Floor	-	-	-	-			
	Slab	50*	45*	-	2250*			
	Windows	0.58	30	51	887			
	Doors	0.49	0	51	0			
	TOTAL ROOM LOSS				~~4959~~ 5791	1.5	1800	1652
2	Ext. walls	~~.081~~ 0.110	260	51	~~1074~~ 1491			
	Ceiling-roof	~~.04~~ 0.07	300	51	~~612~~ 1071			
	Floor	-	-	-	-			
	Slab	50*	35*	-	1750*			
	Windows	.58	0	51	0			
	Doors	.49	20	51	500			
	TOTAL ROOM LOSS				~~3936~~ 4780	1.0	1600	1468
3	Ext. walls	~~.081~~ 0.110	495	51	~~2045~~ 2777			
	Ceiling-roof	~~.04~~ 0.07	500	51	~~1020~~ 1785			
	Floor	-	-	-	-			
	Slab	50*	70*	-	3500*			
	Windows	.58	45	51	1330			
	Doors	.49	20	51	500			
	TOTAL ROOM LOSS				~~8395~~ 9892	2.0	5360	4920

*Slab Loss = Factor from Table XI x Exposed Perimeter Length
Total Conduction Loss = ~~4959~~ + ~~3936~~ + ~~8395~~ = ~~17,290~~ Btu/hr
Total Infiltration Loss = 1652 + 1468 + 4920 = 8,040 Btu/hr
Total Heat Loss = ~~17,290~~ + ~~8,040~~ = ~~25,330~~ Btu/hr

5791 + 4780 + 9892 = 20,463 Btu/hr
20,468 + 8,040 = 28,503 Btu/hr

PROBLEM NO. 4:

Provide the student with building plans. Have them estimate heating loads for your location and compare energy-saving practices. Follow procedures given in manual beginning on page 15. Use Worksheet D provided.

Solution:

1. Determine R-values and U-values for the building components.

	R-Value	U-Value
Walls	_____	_____
Ceilings	_____	_____
Floors	_____	_____
Windows	_____	_____
Doors	_____	_____

2. Determine areas of building components.

Exterior walls	_____ ft^2
Ceiling	_____ ft^2
Windows	_____ ft^2
Doors	_____ ft^2
Floor	_____ ft^2

3. Determine design temperatures and temperature difference from outside and inside.

t_i	_____ °F
t_o	_____ °F
t	_____ °F

4. Calculate heat flow by conduction (qc).

Walls	_____ Btu/hr
Ceilings	_____ Btu/hr
Floor	_____ Btu/hr
Windows	_____ Btu/hr
Doors	_____ Btu/hr
Total	_____ Btu/hr

5. Calculate heat flow by infiltration (qi).

Air exchange in each room	_____ ft^3/hr
qi each room	_____ Btu/hr
qi total	_____ Btu/hr

6. Calculate total heat flow from building.

qc	_____ Btu/hr
qi	_____ Btu/hr
Total	_____ Btu/hr

7. Estimate seasonal heating load (q_s). Follow procedures in manual.

- Estimate seasonal heat loss.

$$q_s = \frac{q \times D \times 24}{t}$$

q_s = _____ Btu/season

- Estimate quantity of fuel required per season.

$$E = q_s \left[\frac{C_D \times C_F}{7 \times V}\right]$$

E = _____ cu. ft. gas

E = _____ gal. fuel oil

E = _____ kwh

8. Compare energy-saving practices.

Find difference in seasonal heat load without energy-efficient practices and with certain energy-efficient practices.

- Estimate load without	_____ Btu/season
- Estimate load with	_____ Btu/season
- Compare fuel required:	
- without	_____ kwh/season
- with	_____ kwh/season

WORKSHEET D. HEAT FLOW CALCULATIONS
Form for Problem No. 4 in Workbook

Overall Heat Transfer Coefficients (U)
Exterior Walls ____ Btu/hr-ft^2-°F
Ceiling-roof combo ____ Btu/hr-ft^2-°F
Floors ____ Btu/hr-ft^2-°F
Slabs ____ Btu/hr-ft
Windows ____ Btu/hr-ft^2-°F
Doors ____ Btu/hr-ft^2-°F

Design Temperatures
Inside temp ____ °F
Outside temp ____ °F

Room	Building Component	Transmission Coefficient (U)	Surface Area (A)	Temp Difference ($t_i - t_o$)	Conduction Losses $q_c = UA(\Delta t)$	Air Exchange	Infiltration Rate (Q_i)	Infiltration Losses $q_i = .018Q_i(\Delta t)$
1	Ext. walls							
	Ceiling-roof							
	Floor							
	Slab							
	Windows							
	Doors							
	TOTAL ROOM LOSS							
2	Ext. walls							
	Ceiling-roof							
	Floor							
	Slab							
	Windows							
	Doors							
	TOTAL ROOM LOSS							
3	Ext. walls							
	Ceiling-roof							
	Floor							
	Slab							
	Windows							
	Doors							
	TOTAL ROOM LOSS							

Total Conduction Loss _____
Total Infiltration Loss _____
Total Heat Loss _____

E. Estimating Cooling Loads in Buildings

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Two, Pages 35-44)

Overview:

This lesson is to explain special adaptations for estimating cooling loads in buildings.

Also, procedures are given for calculating heat gains in buildings and total cooling loads.

Objectives:

The student will be able to perform as follows:

1. Calculate heat gain by buildings.
2. Calculate cooling load.
3. Compare energy-saving practices.

Tools and Materials Needed:

1. Special problem building.
2. Cooling and heating load calculation manual, GRP 158, ASHRAE.

Estimated Time:

6 Hours.

Teaching Strategies:

1. Make reading assignment prior to class.
2. Explain procedures given in manual.
3. Have students work problems in student workbook.
4. Have students work special problem for a given dwelling.

Evaluation:

Check answers to problems in student workbook, pages 30, 31 and 32:

1. Problem No. 1, See Worksheet A.
2. Problem No. 2, See Worksheet B.
3. Evaluate student performance on special problem.

Follow-Up and Reinforcement:

1. Review problems in student workbook.

WORKSHEET A. COOLING LOADS
Answers to Problem No. 1 in Workbook

Overall Heat Transmission Coefficients (U)
Exterior Walls 0.081 Btu/hr-ft²-°F
Ceiling-Roof Combo 0.04 Btu/hr-ft²-°F
Floors ____ Btu/hr-ft²-°F
Slabs 50 Btu/hr-ft²
Windows 0.58 Btu/hr-ft²-°F
Doors 0.49 Btu/hr-ft²-°F

Design Temperatures

Inside temperature	75°F
Outside temperature	~~88°F~~ 96°F
Mean daily range	~~21°F~~ 22°F

Room	Building Component	Heat Transmission Coefficient (U)	Area	ETD	Conduction Sensible Cooling Load (Btu/hr)		Infiltration Factor		Gross Exposed Wall Area	Infiltration Sensible Cooling Load (Btu/hr)	Occupancy Cooling Load (Btu/hr)	Total Sensible Cooling Load (Btu/hr)	Total Cooling Load (Btu/hr)
	Ext. walls	0.081	330	~~18.6~~ 23.6	~~497~~	631							
	Ceiling-roof	0.040	225	~~11.0~~ 36.0	~~229~~	324							
	Floor	-	-	-	-								
	Slab		225	0	0								
1	Doors	0.49	0	~~18.6~~ 23.6	0								
	Window (N)	0.58	15	~~13.0~~ 20.0	~~148~~	174							
	Window (W)	0.58	15	~~56.0~~ 59.0	~~487~~	513							
	Window ( )	-	-	-	-								
	Window ( )	-	-	-	-								
	TOTAL				~~1411~~	1,642	~~1.1~~	1.5	360	~~396~~ 540	1650	~~3457~~ 3,832	~~4891~~ 4,982
	Ext. walls	0.081	260	~~18.6~~ 23.6	~~392~~	497							
	Ceiling-roof	0.040	300	~~11.0~~ 36.0	~~132~~	432							
	Floor	-	-	-	-								
	Slab	-	225	0	0								
2	Doors	0.49	20	~~18.6~~ 23.6	~~182~~	231							
	Window ( )	-	-	-	-								
	Window ( )	-	-	-	-								
	Window ( )	-	-	-	-								
	Window ( )	-	-	-	-								
	TOTAL				~~946~~	1,160	~~1.2~~	1.5	280	~~308~~ 420	0	~~1234~~ 1,580	~~1690~~ 2,054
	Ext. walls	0.081	495	~~18.6~~ 23.6	746								
	Ceiling-roof	0.040	500	~~11.0~~ 36.0	620								
	Floor	-	-	-	-								
	Slab	-	-	-	0								
3	Doors	0.49	20	~~18.6~~ 23.6	182								
	Window (N)	0.58	30	~~13.0~~ 20.0	296								
	Window (E)	0.58	15	~~56.0~~ 59.0	487								
	Window ( )	-	-	-	-								
	Window ( )	-	-	-	-								
	TOTAL				~~2331~~	2,759	~~1.7~~	1.5	560	~~536~~ 840	0	~~2047~~ 3,600	~~3031~~ 4,680

TOTAL COOLING LOAD = ~~4894~~ + ~~1630~~ + ~~3031~~ = ~~9,555~~ Btu/hr 4,982 + 2,054 + 4,680 = 11,716 Btu/hr.

WORKSHEET B. COOLING LOADS
Answers to Problem No. 2 in Workbook

0.11 Overall Heat Transmission Coefficients (U)
Exterior Walls ~~0.081~~ Btu/hr-ft²-°F
Ceiling-Roof Combo ~~0.04~~ Btu/hr-ft²-°F — 0.07
Floors Btu/hr-ft²-°F
Slabs 50 Btu/hr-ft²
Windows 0.58 Btu/hr-ft²-°F
Doors 0.49 Btu/hr-ft²-°F

Design Temperatures
Inside Temperature 75°F
Outside Temperature ~~98~~°F 96°F
Mean Daily Range ~~21~~°F 22°F

Room	Building Component	Heat Transmission Coefficient (U)	Area	ETD	Conduction Sensible Cooling Load (Btu/hr)	Infiltration Factor	Gross Exposed Wall Area	Infiltration Sensible Cooling Load (Btu/hr)	Occupancy Cooling Load (Btu/hr)	Total Sensible Cooling Load (Btu/hr)	Total Cooling Load (Btu/hr)
1	Ext. walls	~~0.081~~ 0.11	330	18.6	~~497~~ 675						
	Ceiling-roof	~~0.040~~ 0.07	225	31.0	~~239~~ 488						
	Floor	-	-	-	-						
	Slab		225	0	0						
	Doors	0.49	0	18.6	0						
	Window (N)	0.58	15	17.0	148						
	Window (W)	0.58	15	56.0	487						
	Window ( )	-	-	-	-						
	Window ( )	-	-	-	-						
	TOTAL				~~1431~~ 1,798	1.1	360	396	1650	3,844 ~~3457~~	4,997 ~~4494~~
2	Ext. walls	~~0.081~~ 0.11	260	18.6	392						
	Ceiling-roof	~~0.040~~ 0.07	300	31.0	372						
	Floor	-	-	-	-						
	Slab	-	225	0	0						
	Doors	0.49	20	18.6	182						
	Window ( )	-	-	-	-						
	Window ( )	-	-	-	-						
	Window ( )	-	-	-	-						
	Window ( )	-	-	-	-					1,673	2,175
	TOTAL				946	1.1	280	308	0	~~1254~~	~~1630~~
3	Ext. walls	~~0.081~~ 0.11	495	18.6	~~746~~ 1,103						
	Ceiling-roof	~~0.040~~ 0.07	500	31.0	~~620~~ 1,085						
	Floor	-	-	-	-						
	Slab	-	-	-	0						
	Doors	0.49	20	18.6	182						
	Window (N)	0.58	30	17.0	296						
	Window (E)	0.58	15	56.0	487						
	Window ( )	-	-	-	-						
	Window ( )	-	-	-	-					3,679	4,782
	TOTAL				~~2331~~ 3,065	1.1	560	616	0	~~2947~~	~~3831~~

TOTAL COOLING LOAD = ~~4494~~ 4,997 + ~~1630~~ 2,175 + ~~3831~~ 4,782 = ~~9955~~ 11,954 Btu/hr

WORKSHEET C. COOLING LOADS
Form for Problem No. 3 in Workbook

Overall Heat Transmission Coefficients (U)
Exterior Walls ____ Btu/hr-ft^2-°F
Ceiling-Roof Combo ____ Btu/hr-ft^2-°F
Floors ____ Btu/hr-ft^2-°F
Slabs ____ Btu/hr-ft^2
Windows ____ Btu/hr-ft^2-°F
Doors ____ Btu/hr-ft^2-°F

Design Temperatures
Inside Temperature
Outside Temperature
Mean Daily Range

Room	Building Component	Heat Transmission Coefficient (U)	Area	ETD	Conduction Sensible Cooling Load (Btu/hr)	Infiltration Factor	Gross Exposed Wall Area	Infiltration Sensible Cooling Load (Btu/hr)	Occupancy Cooling Load (Btu/hr)	Total Sensible Cooling Load (Btu/hr)	Total Cooling Load (Btu/hr)
	Ext. walls										
	Ceiling-roof										
	Floor										
	Slab										
1	Doors										
	Window (N)										
	Window (W)										
	Window ( )										
	Window ( )										
	TOTAL										
	Ext. walls										
	Ceiling-roof										
	Floor										
	Slab										
2	Doors										
	Window ( )										
	Window ( )										
	Window ( )										
	Window ( )										
	TOTAL										
	Ext. walls										
	Ceiling-roof										
	Floor										
	Slab										
3	Doors										
	Window (N)										
	Window (E)										
	Window ( )										
	Window ( )										
	TOTAL										

TOTAL COOLING LOAD =

3 I

F. Determining Cost Benefits of Using Energy-Saving Practices

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Two, Pages 45-47)

Overview:

This lesson is to explain the benefit/cost ratio and tell how to compute it. Also, "payback period" and "time to recoup investment" are explained.

Objectives:

The student will be able to perform as follows:

1. Calculate cost benefits and payback periods for a number of variables.

Tools and Materials Needed:

1. Tables in manual.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Make reading assignment prior to class.
2. Explain procedures given in manual.
3. Have students answer questions in student workbook.
4. Have students work problems in student workbook.

Evaluation:

1. Check answers to questions and problems, pages 36 and 37, in student workbook as follows:

   1b; 2a; 3b; 4b.
   Problem No. 1, 3.8 B/c.
   Problem No. 2, 2 years.
   Problem No. 3, 2.35 years.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

Part Three:
SELECTING AND INSTALLING ENERGY-EFFICIENT MATERIALS AND EQUIPMENT

I. Determining Which Measures Are the Most Efficient and Economical

A. What Site to Choose

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 11-14)

Overview:

This lesson is to point out the advantages of carefully choosing a site by describing factors that affect energy consumption.

Objectives:

The student will be able to perform as follows:

1. Select a building site and orientation that is energy efficient.

Tools and Materials Needed:

1. Audiovisual.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Assign reading prior to class.
2. Discuss subject and show audiovisual.
3. Have students answer questions in student workbook.
4. Conduct exercise in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 39, as follows:

   1f; 2a; 3-1d, 2a, 3b, 4c; 4-c1, c2, c3, b4, a5, b6, a7, d8; 5-1a, 2b, 3c; 6f.

2. Evaluate student performance with exercises.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

B. What Design to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 14-23)

Overview:

This lesson is to explain design factors affecting energy consumption.

Objectives:

Student will be able to perform as follows:

1. Decide what design features to use for energy efficiency.

Tools and Materials Needed:

1. Audiovisual.

2. Examples.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Assign reading prior to class.

2. Discuss subject and show examples and audiovisual.

3. Have students answer questions in student workbook.

4. Assign exercise in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 40, as follows:

   1a; 2b; 3abc; 4-1a, 2b, 3c; 5a; 6b; 7a; 8d; 9b; 10-1c, 2b, 3d, 4a; 11a; 12b; 13b; 14a; 15b; 16b.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

C. What Construction Materials to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Page 24)

Overview:

This lesson is to point out the relative values of different types of construction materials in saving energy.

Objectives:

Students will be able to perform as follows:

1. Select energy-efficient construction materials.

Tools and Materials Needed:

1. Table I.

2. Example of construction materials.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Assign reading prior to class.

2. Assign exercise.

3. Discuss subject and show examples of construction material.

4. Have students answer questions in student workbook and perform exercise.

Evaluation:

1. Check answers to questions in student workbook, page 45, as follows:

   1f; 2b; 3a; 4a; 5a.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

D. What Type and How Much Insulation to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 24-34)

Overview:

This lesson is to describe different types of insulation and to recommend the amounts needed in the various climates for energy efficiency.

Objectives:

The student will be able to perform as follows:

1. Decide how much insulation to use in a building.
2. Decide which type of insulation to use.

Tools and Materials Needed:

1. Audiovisual.
2. Table III. R-Values of Insulation.
3. Examples of insulation.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Assign reading prior to class.
2. Assign exercise.
3. Show audiovisual and discuss subject. Show examples.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 46, as follows:

   1b; 2a; 3c; 4c; 5e; 6d; 7abc; 8c; 9c; 10a; 11c; 12b; 13a; 14a; 15b; 16b; 17-__, __, __; 18ab.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.
2. Encourage students to continue interest in insulation for energy efficiency.

E. What Type of Vapor Barrier to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 34-35)

Overview:

This lesson is to acquaint the student with the importance of barriers and to describe types of vapor barriers.

Objectives:

Student will be able to perform the following:

1. Select the proper vapor barrier to use.

Tools and Materials Needed:

1. Examples of vapor barrier materials.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Assign reading prior to class.
2. Assign exercise.
3. Discuss subject and show examples of vapor barriers.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 48, as follows:

   1abc; 2a; 3a.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

F. What Type and How Much Weatherstripping and Caulking to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 35-40)

Overview:

This lesson is to describe types and characteristics of caulking and weatherstripping and how they influence energy efficiency.

Objectives:

The student will be able to perform as follows:

1. Select the proper caulking and weatherstripping.

Tools and Materials Needed:

1. Table V. Characteristics of Different Types of Weatherstripping.
2. Table VI. Characteristics of Different Types of Caulking.
3. Examples of weatherstripping and caulking.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Assign reading prior to class.
2. Assign exercises.
3. Discuss subject and show examples.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 49, as follows:

   1bcd; 2a; 3e; 4a; 5b; 6d; 7b.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Discuss questions and answers in student workbook.

G. What Type of Windows to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 41-46)

Overview:

This lesson is to describe types and characteristics of windows with regard to energy efficiency.

Objectives:

The student will be able to perform as follows:

1. Decide which types of windows are most energy efficient.

Tools and Materials Needed:

1. Audiovisual.
2. Examples of windows.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Assign reading prior to class. Show audiovisual.
2. Assign exercise.
3. Discuss subject and point out examples.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 50, as follows:

   1e; 2a; 3b; 4b; 5abc; 6abc; 7b.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

H. What Type of Doors to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 46-48)

Overview:

This lesson is to describe types of doors and factors influencing energy efficiency.

Objectives:

The student will be able to perform as follows:

1. Decide type of doors that are most energy efficient.

Tools and Materials Needed:

1. Audiovisual.
2. Examples of doors.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Assign reading prior to class.
2. Assign exercise.
3. Show audiovisual, discuss lesson and point out examples.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 51, as follows:

   1abc; 2c; 3b.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

I. What Type of Heating Equipment to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 49-56)

Overview:

This lesson is to describe types of heating equipment and give some characteristics of each with regard to efficiency.

Objectives:

The student will be able to perform as follows:

1. Decide which type of heating equipment is the most energy efficient.

Tools and Materials Needed:

1. Audiovisual.
2. Examples of heating units.

Estimated Time:

1 Hour.

Teaching Strategies:

1. Assign reading prior to class.
2. Assign exercise.
3. Show audiovisual, discuss subject and point out examples.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 52, as follows:

   1e, 2b; 3a; 4a; 5a; 6b; 7-1d, 2b, 3a, 4e, 5c; 8d; 9a; 10a.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

J. What Type of Air Conditioners to Use if Needed

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 57-61)

Overview:

This lesson is to discuss air conditioning equipment and the factors influencing energy efficiency.

Objectives:

The student will be able to perform as follows:

1. Describe the types of air conditioning equipment.
2. Decide what efficiency rating is best.

Tools and Materials Needed:

1. Audiovisual.
2. Examples of air conditioners and EER's.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Assign reading prior to class.
2. Assign exercise.
3. Show audiovisual, discuss subject and point out examples.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 53, as follows:

   1abc; 2abc; 3b; 4a; 5b; 6a; 7a.

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

K. What Type of Ventilation to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 62-66)

Overview:

This lesson is to explain the need for proper ventilation and how it should be accomplished.

Objectives:

The student will be able to perform as follows:

1. Explain how proper ventilation is accomplished.

Tools and Materials Needed:

1. Audiovisual.

2. Examples of ventilation.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Assign reading prior to class.

2. Assign exercise.

3. Show audiovisual and discuss subject.

4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 54, as follows:

   1b; 2b; 3a; 4ab; 5d; 6ab; 7b; 8a; 9c.

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

L. What Type of Lighting to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 67-68)

Overview:

This lesson is to explain how different types of lighting may affect energy efficiency.

Objectives:

The student will be able to perform as follows:

1. Select the most efficient lighting.

Tools and Materials Needed:

1. Audiovisual.

2. Examples of light bulbs.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Assign reading prior to class.

2. Show audiovisual, discuss subject and show examples.

3. Assign exercise.

4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 55, as follows:

   1a; 2a; 3b.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

M. What Type of Water Heater to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 70-71)

Overview:

This lesson is to explain how energy can be saved by efficient selection and use of water heaters.

Objectives:

The student will be able to perform as follows:

1. Select the most efficient type and size of water heater.

Tools and Materials Needed:

1. Audiovisual.

2. Examples.

Estimated Time:

1/2 Hour.

Teaching Strategies:

1. Assign reading prior to class.

2. Assign exercise.

3. Show audiovisual, discuss subject and point out examples.

4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 56, as follows:

   1a; 2b; 3a.

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

N. What Type of Plumbing to Use

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 72-75)

Overview:

This lesson is to discuss factors influencing energy conservation in plumbing fixtures and appliances.

Objectives:

The student will be able to perform as follows:

1. Select and use plumbing fixtures and appliances efficiently.

Tools and Materials Needed:

1. Audiovisual.
2. Examples of energy savings in plumbing and appliances.

Teaching Strategies:

1. Assign reading prior to class.
2. Assign exercise.
3. Show audiovisual, discuss subject and point out examples.
4. Have students answer questions in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 56, as follows:

   1b; 2a; 3b.

2. Evaluate student performance with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

II. Installing Energy-Saving Materials

A. 1. Installing Insulation in the Ceiling

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 75-83)

Overview:

This lesson is to give procedures for installing insulation in ceilings.

Objectives:

The student will be able to perform as follows:

1. Install insulation in ceilings properly.

Tools and Materials Needed:

1. Audiovisual.
2. Insulation batts or rolls.
3. Loose-fill insulation.
4. Rigid insulation.
5. Staple gun.
6. Measuring tape.
7. Knife.
8. Models of ceiling construction.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Assign reading prior to class.
2. Show audiovisual and demonstrate procedures.
3. Have students answer questions in student workbook.
4. Have students install insulation in a section of ceiling as directed in the manual.

Evaluation:

1. Check answers to questions in student workbook, page 57, as follows:

   1b; 2c; 3b; 4c; 5e; 6a; 7b; 8a; 9a; 10c; 11a; 12c; 13b; 14c; 15b; 16a; 17b; 18c; 19a; 20a; 21a; 22 (See Figure 4).

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

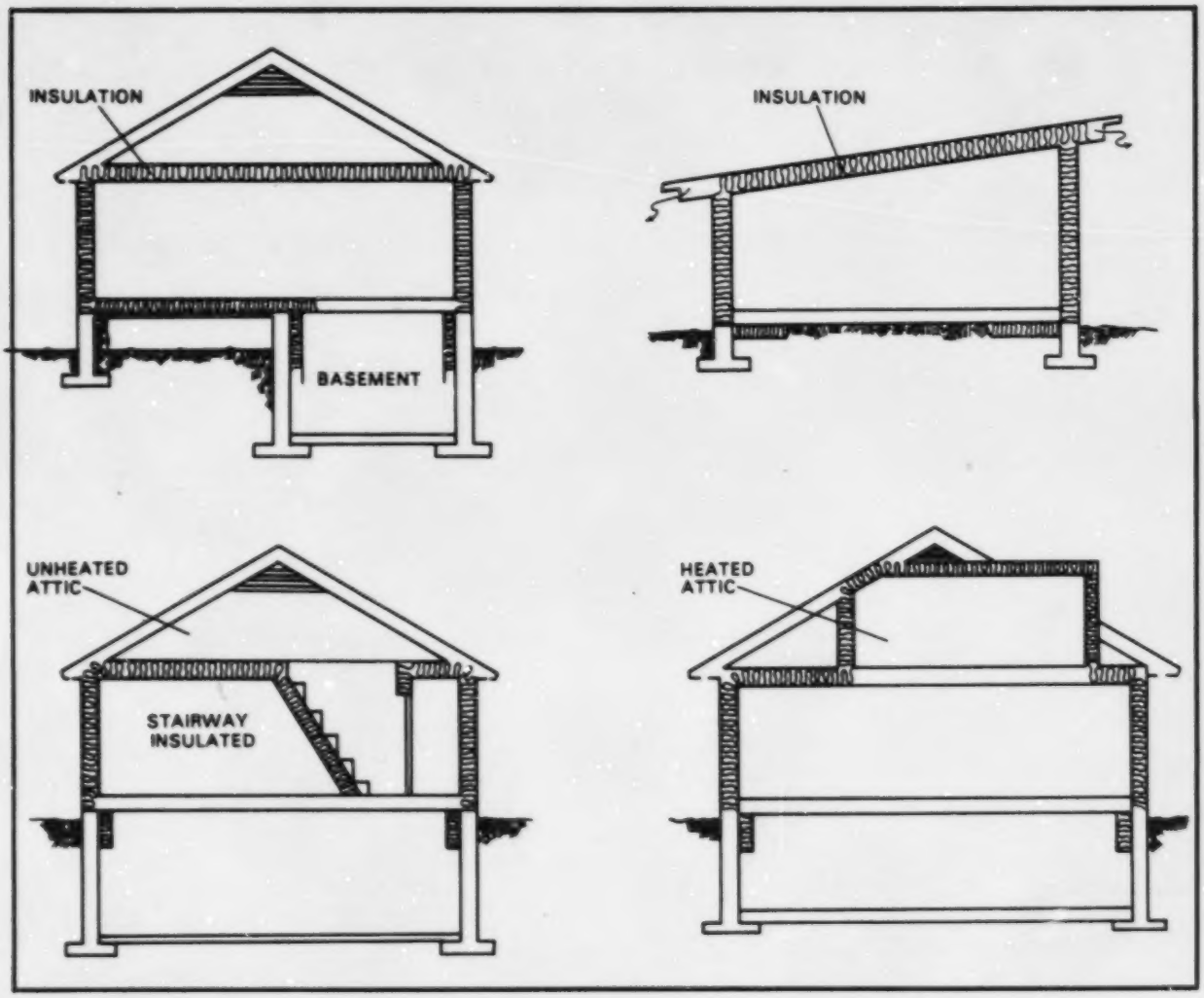

INSULATION
BASEMENT
INSULATION
UNHEATED
ATTIC
STAIRWAY
INSULATED
HEATED
ATTIC

FIGURE 4

A. 2. Installing Insulation in the Floor

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 83-85)

Overview:

This lesson is to give procedures for installing insulation in floors.

Objectives:

The student will be able to perform as follows:

1. Install insulation in floors properly.

Tools and Materials Needed:

1. Audiovisual.
2. Insulation batts or rolls.
3. Rigid insulation.
4. Measuring tape.
5. Staple gun.
6. Steel wire or mesh wire.
7. Wire cutters.
8. Models of floors or actual floors.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Assign reading prior to class.
2. Show audiovisual and demonstrate procedures.
3. Have students answer questions in student workbook.
4. Have students install insulation in a section of flooring as directed in the manual.

Evaluation:

1. Check answers to questions in student workbook, page 61, as follows:

   1a; 2a; 3a; 4b; 5c; 6a; 7d; 8b; 9 (See Figure 4).

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

A. 3. Installing Insulation in the Walls

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 86-89)

Overview:

This lesson is to give procedures for installing insulation in walls.

Objectives:

The student will be able to perform as follows:

1. Install insulation in walls properly.

Tools and Materials Needed:

1. Audiovisual.
2. Loose-fill insulation.
3. Insulation batts or rolls.
4. Rigid insulation.
5. Measuring tape.
6. Staple gun.
7. Blower for loose-fill.
8. Models of walls or actual walls.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Assign reading prior to class.
2. Show audiovisual and demonstrate procedures.
3. Have students answer questions in student workbook.
4. Have students install insulation in a wall section as directed in manual.

Evaluation:

1. Check answers to questions in student workbook, page 62, as follows:

   1b; 2f; 3a; 4a; 5c; 6a; 7c; 8b; 9c; 10c; 11b; 12a; 13d; 14a; 15 (See Figure 4).

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

A. 4. Installing Insulation in the Basement and Crawl Space

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 89-90)

Overview:

This lesson is to give procedures for installing insulation in crawl space.

Objectives:

The student will perform as follows:

1. Install insulation in crawl space properly.

Tools and Materials Needed:

1. Audiovisual.
2. Batt or roll insulation.
3. Staple gun.
4. Measuring tape.
5. Knife.
6. Crawl space for exercise.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Assign reading prior to class.
2. Show audiovisual and demonstrate procedures.
3. Have students answer questions in student workbook.
4. Have students install insulation in a section of crawl space.

Evaluation:

1. Check answers to questions in student workbook, page 64, as follows:

   1c; 2a; 3b; 4b; 5b; 6a; 7a; 8a; 9 (See Figure 4).

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

B. Installing Vapor Barrier

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 91-92)

Overview:

This lesson is to give procedures for installing vapor barriers.

Objectives:

The student will be able to perform as follows:

1. Install vapor barriers properly.

Tools and Materials Needed:

1. 4 mil polyethylene.
2. Staple gun.
3. Tape.
4. Knife.
5. Measuring tape.
6. Stud wall section.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Assign reading prior to class.
2. Demonstrate procedures.
3. Have students answer questions in student workbook.
4. Have students install vapor barrier in a wall section.

Evaluation:

1. Check answers to questions in student workbook, page 65, as follows:

   1d; 2 (See Figure 5); 3a; 4b; 5a; 6b; 7d; 8a.

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

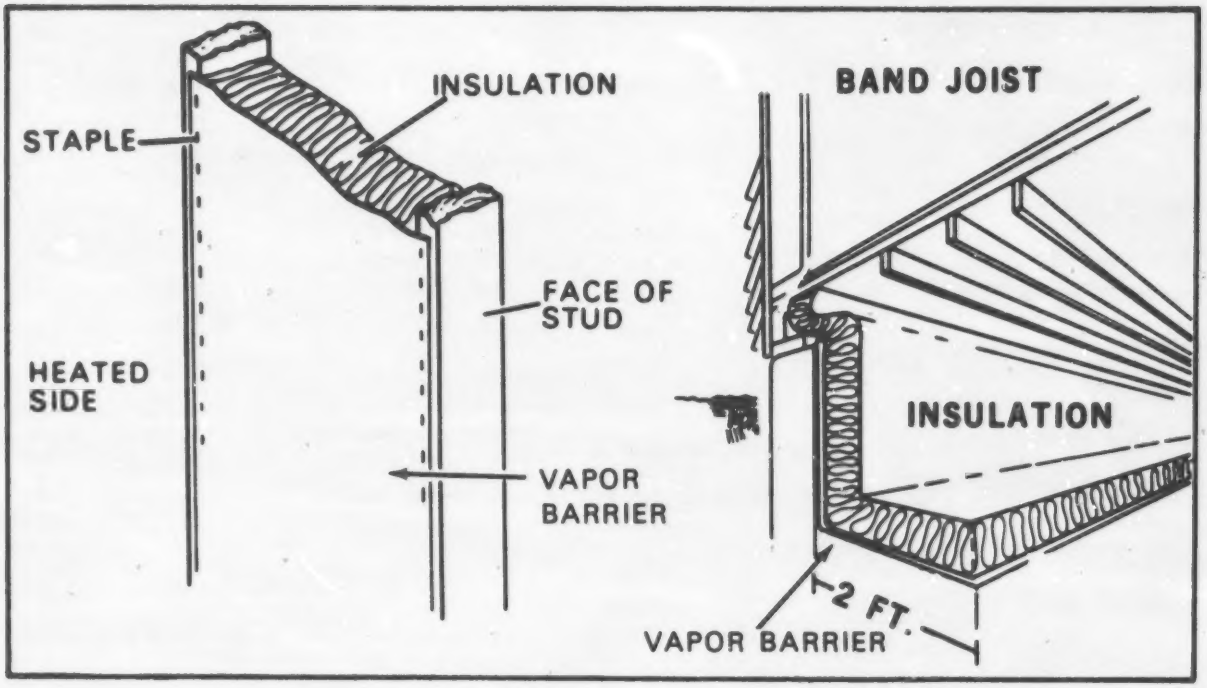


FIGURE 5

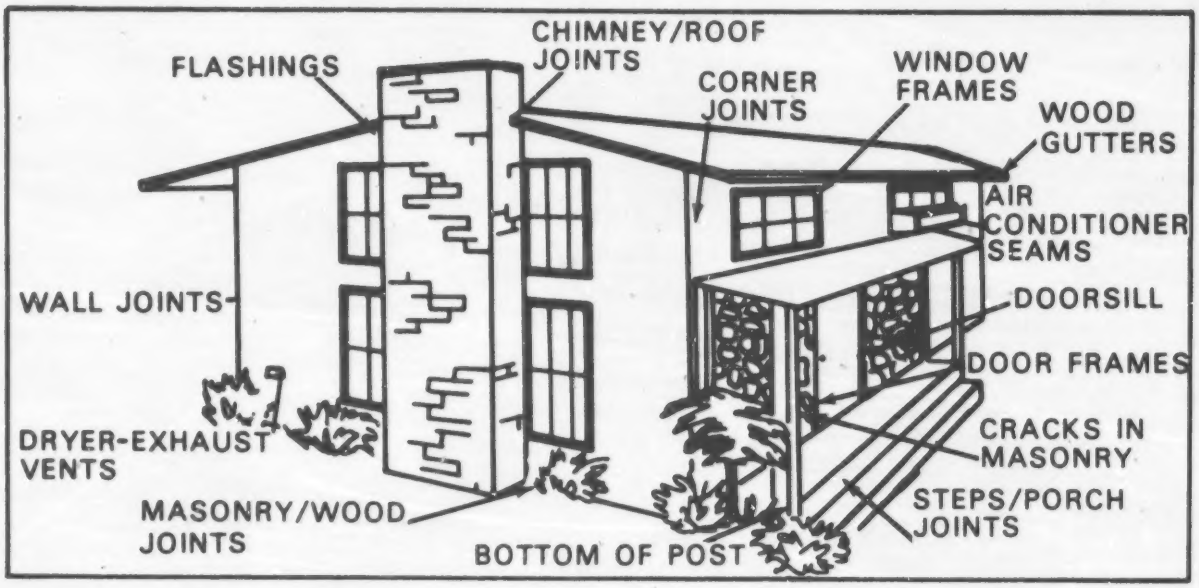


FIGURE 6

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C. Installing Weatherstripping and Caulking

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 93-97)

Overview:

This lesson is to give procedures for installing weatherstripping and caulking.

Objectives:

The student will be able to perform as follows:

1. Install weatherstripping and caulking properly.

Tools and Materials Needed:

1. Audiovisual.
2. Weatherstripping.
3. Caulking.
4. Caulking gun.
5. Staple gun.
6. Measuring tape.
7. Screwdriver.
8. Model for installing weatherstripping and caulking.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Assign reading prior to class.
2. Show audiovisual and demonstrate procedures.
3. Have students answer questions in student workbook.
4. Have students install weather-stripping and caulking as directed in manual.

Evaluation:

1. Check answers to questions in student workbook, page 67, as follows:

   1-air infiltration; 2-windows and door; 3a; 4a; 5e; 6a; 7c; 8b; 9a; 10 (See Figure 6).

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

D. Installing Storm Windows and Doors

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 97-102)

Overview:

This lesson is to give procedures for installing storm windows and doors.

Objectives:

The student will be able to perform as follows:

1. Install storm windows and doors properly.

Tools and Materials Needed:

1. Audiovisual.
2. Storm windows.
3. Storm doors.
4. Screwdriver.
5. Measuring tape.
6. Knife.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Assign reading prior to class.
2. Show audiovisual and demonstrate procedure.
3. Have students answer questions in student workbook.
4. Have students install a storm window or a storm door.

Evaluation:

1. Check answers to questions in student workbook, page 68, as follows:

   1a; 2e; 3a; 4d; 5b; 6c; 7b; 8a; 9c; 10a; 11b; 12b; 13b.

2. Evaluate student performance during exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.

III. Improving Efficiency of Equipment

(Ref. PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS, Part Three, Pages 103-111)

Overview:

This lesson is to describe methods of improving efficiency of systems and equipment.

Objectives:

The student will be able to perform as follows:

1. Improve efficiency of systems and equipment.

Tools and Materials Needed:

1. Audiovisual.

Estimated Time:

2 Hours.

Teaching Strategies:

1. Assign reading prior to class.
2. Show audiovisual.
3. Discuss system and demonstrate procedures.
4. Have students answer questions and perform exercise in student workbook.

Evaluation:

1. Check answers to questions in student workbook, page 70, as follows:

   1e; 2a; 3b; 4a; 5c; 6d; 7e; 8a; 9c; 10d; 11a; 12a; 13a; 14a; 15b; 16a.

2. Evaluate performance of students with exercise.

Follow-Up and Reinforcement:

1. Review questions and answers in student workbook.